AMENDMENTS TO THE CLAIMS

Please cancel claims 3, 8, 15, 21, 26, 29, 34, 39, 43, 47, and 52, add claims 56-67, and amend the claims as follows:

1. (Currently Amended) A method for forming a ~~film~~ ruthenium material on a substrate surface, comprising:

positioning a substrate within a process chamber;

exposing a ruthenium-containing compound to the substrate while forming a ruthenium-containing compound film thereon, wherein the ruthenium-containing compound is selected from the group consisting of bis(dialkylpentadienyl) ruthenium compounds, bis(alkylpentadienyl) ruthenium compounds, bis(pentadienyl) ruthenium compounds, and combinations thereof;

purging the process chamber with a purge gas;

exposing a reducing gas comprising ammonia and atomic hydrogen to the ruthenium-containing compound ~~with a reductant to~~ film on the substrate while forming a ruthenium layer thereon ~~the substrate~~; and

purging the process chamber with the purge gas.

2. (Previously Presented) The method of claim 1, wherein the ruthenium-containing compound comprises at least one alkyl group selected from the group consisting of methyl, ethyl, propyl, butyl, and combinations thereof.

3. (Cancelled) ~~The method of claim 2, wherein the at least one alkyl group is methyl.~~

4. (Currently Amended) The method of claim 2, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, bis(2,4-diethylpentadienyl) ruthenium, bis(2,4-diisopropylpentadienyl) ruthenium, bis(2,4-ditertbutylpentadienyl) ruthenium, bis(methylpentadienyl) ruthenium,

bis(ethylpentadienyl) ruthenium, bis(isopropylpentadienyl) ruthenium, bis(tertbutylpentadienyl) ruthenium, derivatives thereof, and combinations thereof.

5. (Currently Amended) The method of claim [[4]] 1, wherein the ~~reductant~~ reducing gas further comprises ~~one or more reagents~~ a carrier gas selected from the group consisting of ~~oxygen, nitrous oxide, nitric oxide, nitrogen dioxide~~ nitrogen gas, argon, and combinations thereof.

6. (Previously Presented) The method of claim 5, wherein the ruthenium layer is formed at a temperature within a range from about 200°C to about 400°C.

7. (Currently Amended) The method of claim 6, wherein a thickness of the ruthenium layer is about ~~100~~ 20 Å ~~and the ruthenium layer has a resistivity of~~ or less ~~than 15 μΩ-cm~~.

8. (Cancelled) The ~~method of claim 6, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

9. (Currently Amended) The method of claim [[4]] 1, wherein the substrate ~~surface~~ further comprises a barrier layer selected from the group consisting of tantalum, tantalum nitride, tantalum silicon nitride, titanium, titanium nitride, titanium silicon nitride, tungsten, tungsten nitride, and combinations thereof, and the ruthenium layer is deposited on the barrier layer.

10. (Currently Amended) The method of claim [[4]] 1, wherein the substrate ~~surface~~ further comprises at least one low-k material selected from the group consisting of silicon dioxide, silicon nitride, silicon oxynitride, carbon-doped silicon oxides, ~~SiO_xC_y~~ silicon oxide carbide, and combinations thereof, and the ruthenium layer is deposited on the low-k material.

11. (Currently Amended) A method for forming a ~~layer comprising~~ ruthenium material on a substrate surface within a process chamber, sequentially comprising:

[[a)]] exposing a substrate to bis(2,4-dimethylpentadienyl) ruthenium to form a ruthenium-containing ~~layer~~ film on the substrate;

[[b)]] purging the process chamber with a purge gas;

~~c) reacting~~ exposing a reducing gas ~~with~~ comprising ammonia to the ruthenium-containing ~~layer~~ film while forming a ruthenium layer thereon; and

[[d)]] purging the process chamber with the purge gas.

12. (Currently Amended) The method of claim 11, wherein the ~~reductant~~ reducing gas further comprises ~~one or more reagents~~ a carrier gas selected from the group consisting of ~~oxygen, nitrous oxide, nitric oxide, nitrogen dioxide~~ nitrogen gas, argon, and combinations thereof.

13. (Previously Presented) The method of claim 12, wherein the layer is formed at a temperature within a range from about 200°C to about 400°C.

14. (Currently Amended) The method of claim 13, wherein a thickness of the ruthenium layer is about ~~100~~ 20 Å ~~and the ruthenium layer has a resistivity of~~ or less ~~than 15 μΩ-cm~~.

15. (Cancelled)~~The method of claim 13, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

16. (Currently Amended) The method of claim 12, wherein the substrate further comprises a barrier layer comprising a material selected from the group consisting of tantalum, tantalum nitride, tantalum silicon nitride, titanium, titanium nitride, titanium silicon nitride, tungsten, tungsten nitride, and combinations thereof, and the ruthenium layer is deposited on the barrier layer.

17. (Currently Amended) The method of claim 12, wherein the substrate further comprises at least one low-k material selected from the group consisting of silicon dioxide, silicon nitride, silicon oxynitride, carbon-doped silicon oxides, ~~SiO_xC_y~~ silicon oxide carbide, and combinations thereof, and the ruthenium layer is deposited on the low-k material.

18. (Cancelled)

19. (Currently Amended) A method for forming a ruthenium material on a substrate, comprising:

depositing a barrier layer on a substrate during a first ALD process, wherein the barrier layer comprises a material selected from the group consisting of tantalum, tantalum nitride, tantalum silicon nitride, titanium, titanium nitride, titanium silicon nitride, tungsten, tungsten nitride, and combinations thereof; and

exposing the substrate sequentially to a ruthenium-containing compound and a reducing gas comprising ammonia to form a ruthenium layer on the barrier layer during a second ALD process, wherein the ruthenium-containing compound is selected from the group consisting of bis(dialkylpentadienyl) ruthenium compounds, bis(alkylpentadienyl) ruthenium compounds, bis(pentadienyl) ruthenium compounds, and combinations thereof.

20. (Previously Presented) The method of claim 19, wherein the ruthenium-containing compound comprises at least one alkyl group selected from the group consisting of methyl, ethyl, propyl, butyl, and combinations thereof.

21. (Cancelled) ~~The method of claim 20, wherein the at least one alkyl group is methyl.~~

22. (Currently Amended) The method of claim [[19]] 20, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, bis(2,4-diethylpentadienyl) ruthenium, bis(2,4-

diisopropylpentadienyl) ruthenium, bis(2,4-ditertbutylpentadienyl) ruthenium, bis(methylpentadienyl) ruthenium, bis(ethylpentadienyl) ruthenium, bis(isopropylpentadienyl) ruthenium, bis(tertbutylpentadienyl) ruthenium, <u>derivatives thereof,</u> and combinations thereof.

23. (Currently Amended) The method of claim 19, wherein the ~~reductant~~ <u>reducing gas further</u> comprises ~~one or more reagents~~ <u>a carrier gas</u> selected from the group consisting of ~~oxygen, nitrous oxide, nitric oxide, nitrogen dioxide~~ <u>nitrogen gas, argon</u>, and combinations thereof.

24. (Previously Presented) The method of claim 23, wherein the ruthenium layer is formed at a temperature within a range from about 200°C to about 400°C.

25. (Currently Amended) The method of claim 24, wherein a thickness of the ruthenium layer is about ~~100~~ <u>20</u> Å ~~and the ruthenium layer has a resistivity of~~ <u>or</u> less ~~than 15 μΩ-cm~~.

26. (Cancelled) ~~The method of claim 24, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

27. (Currently Amended) A method for forming a ruthenium film on a dielectric material <u>disposed</u> on a substrate <u>surface</u>, comprising:

positioning ~~the~~ <u>a</u> substrate <u>comprising a dielectric layer thereon</u> within a process chamber;

exposing a ruthenium-containing compound to the dielectric ~~material~~ <u>layer while forming a ruthenium-containing compound film thereon</u>, wherein the ruthenium-containing compound is selected from the group consisting of bis(dialkylpentadienyl) ruthenium compounds, bis(alkylpentadienyl) ruthenium compounds, bis(pentadienyl) ruthenium compounds, and combinations thereof;

purging the process chamber with a purge gas;

exposing a reducing gas comprising ammonia to the ruthenium-containing compound ~~with a reductant to~~ film on the dielectric layer while forming a ~~the~~ ruthenium layer thereon ~~the dielectric material~~; and

purging the process chamber with the purge gas.

28. (Previously Presented) The method of claim 27, wherein the ruthenium-containing compound comprises at least one alkyl group selected from the group consisting of methyl, ethyl, propyl, butyl, and combinations thereof.

29. (Cancelled) ~~The method of claim 28, wherein the at least one alkyl group is methyl.~~

30. (Currently Amended) The method of claim 28, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, bis(2,4-diethylpentadienyl) ruthenium, bis(2,4-diisopropylpentadienyl) ruthenium, bis(2,4-ditertbutylpentadienyl) ruthenium, bis(methylpentadienyl) ruthenium, bis(ethylpentadienyl) ruthenium, bis(isopropylpentadienyl) ruthenium, bis(tertbutylpentadienyl) ruthenium, derivatives thereof, and combinations thereof.

31. (Currently Amended) The method of claim 27, wherein the ~~reductant~~ reducing gas further comprises ~~one or more reagents~~ a carrier gas selected from the group consisting of ~~oxygen, nitrous oxide, nitric oxide, nitrogen dioxide~~ nitrogen gas, argon, and combinations thereof.

32. (Previously Presented) The method of claim 31, wherein the ruthenium layer is formed at a temperature within a range from about 200°C to about 400°C.

33. (Currently Amended) The method of claim 32, wherein a thickness of the ruthenium layer is about ~~100~~ 20 Å ~~and the ruthenium layer has a resistivity of~~ or less ~~than 15 μΩ-cm~~.

34. (Cancelled) The~~ method of claim 32, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

35. (Currently Amended) The method of claim [[30]] <u>27</u>, wherein the dielectric ~~material~~ <u>layer</u> comprises at least one low-k material selected from the group consisting of silicon dioxide, silicon nitride, silicon oxynitride, carbon-doped silicon oxides, ~~SiO_xC_y~~ <u>silicon oxide carbide</u>, and combinations thereof.

36. (Currently Amended) A method for forming a ruthenium ~~layer~~ <u>material</u> on a substrate surface, comprising:

positioning a substrate within a process chamber;

exposing the substrate to a ruthenium-containing compound comprising ruthenium and at least one open chain dienyl ligand [[;]] <u>while</u> forming a ruthenium-containing compound film <u>there</u>on ~~the substrate~~;

purging the process chamber with a purge gas;

~~reducing~~ <u>exposing</u> the ruthenium-containing compound film ~~with a reductant~~ <u>to a reducing gas</u> comprising ~~at least one reagent selected from the group consisting of oxygen, nitrous oxide, nitric oxide, nitrogen dioxide, and combinations thereof~~ <u>ammonia and hydrogen gas while forming a ruthenium layer on the substrate</u>; and

purging the process chamber with the purge gas.

37. (Original) The method of claim 36, wherein the ruthenium-containing compound is selected from the group consisting of bis(dialkylpentadienyl) ruthenium compounds, bis(alkylpentadienyl) ruthenium compounds, bis(pentadienyl) ruthenium compounds, and combinations thereof.

38. (Previously Presented) The method of claim 37, wherein the ruthenium-containing compound comprises at least one alkyl group selected from the group consisting of methyl, ethyl, propyl, butyl, and combinations thereof.

39. (Cancelled)~~ The method of claim 38, wherein the at least one alkyl group is methyl.~~

40. (Currently Amended) The method of claim [[36]] 38, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, bis(2,4-diethylpentadienyl) ruthenium, bis(2,4-diisopropylpentadienyl) ruthenium, bis(2,4-ditertbutylpentadienyl) ruthenium, bis(methylpentadienyl) ruthenium, bis(ethylpentadienyl) ruthenium, bis(isopropylpentadienyl) ruthenium, bis(tertbutylpentadienyl) ruthenium, derivatives thereof, and combinations thereof.

41. (Previously Presented) The method of claim [[40]] 36, wherein the ruthenium layer is formed at a temperature within a range from about 200°C to about 400°C.

42. (Currently Amended) The method of claim 41, wherein a thickness of the ruthenium layer is about ~~100~~ 20 Å ~~and the ruthenium layer has a resistivity of~~ or less ~~than 15 μΩ-cm~~.

43. (Cancelled)~~ The method of claim 41, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

44. (Currently Amended) A method for forming a ruthenium ~~layer~~ material on a low-k material disposed on a substrate surface, comprising:

positioning a substrate ~~containing the~~ comprising a low-k ~~material~~ layer disposed thereon within a process chamber;

~~maintaining~~ heating the substrate [[at]] to a temperature within a range from about 200°C to about 400°C;

exposing the low-k ~~material~~ layer to a ruthenium-containing compound comprising ruthenium and at least one open chain dienyl ligand [[;]] while forming a ruthenium-containing compound film thereon ~~the low-k material~~;

purging the process chamber with a purge gas;

~~reducing~~ exposing the ruthenium-containing compound film ~~with a reductant~~ to a reducing gas comprising ~~an oxygen-containing gas~~ ammonia while forming a ruthenium layer on the low-k layer; and

purging the process chamber with the purge gas.

45. (Previously Presented) The method of claim 44, wherein the temperature is within a range from about 300°C to about 350°C.

46. (Currently Amended) The method of claim 45, wherein a thickness of the ruthenium layer is about ~~100~~ 20 Å ~~and the ruthenium layer has a resistivity of~~ or less ~~than 15 μΩ-cm~~.

47. (Cancelled) ~~The method of claim 45, wherein the ruthenium layer has a sheet resistance of less than 2,000 Ω/sq.~~

48. (Currently Amended) The method of claim 44, wherein the low-k ~~material~~ layer comprises at least one material selected from the group consisting of silicon dioxide, silicon nitride, silicon oxynitride, carbon-doped silicon oxides, ~~SiO_xC_y~~ silicon oxide carbide, and combinations thereof.

49. (Currently Amended) The method of claim [[48]] 44, wherein the ~~oxygen-containing~~ reducing gas further comprises ~~at least one reagent selected from the group consisting of oxygen, nitrous oxide, nitric oxide, nitrogen dioxide, and combinations thereof~~ hydrogen gas and nitrogen gas.

50. (Currently Amended) The method of claim [[49]] 44, wherein the ruthenium-containing compound is selected from the group consisting of bis(dialkylpentadienyl) ruthenium compounds, bis(alkylpentadienyl) ruthenium compounds, bis(pentadienyl) ruthenium compounds, and combinations thereof.

51. (Previously Presented) The method of claim 50, wherein the ruthenium-containing compound comprises at least one alkyl group selected from the group consisting of methyl, ethyl, propyl, butyl, and combinations thereof.

52. (Cancelled)~~The method of claim 51, wherein the at least one alkyl group is methyl.~~

53. (Currently Amended) The method of claim [[48]] 51, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, bis(2,4-diethylpentadienyl) ruthenium, bis(2,4-diisopropylpentadienyl) ruthenium, bis(2,4-ditertbutylpentadienyl) ruthenium, bis(methylpentadienyl) ruthenium, bis(ethylpentadienyl) ruthenium, bis(isopropylpentadienyl) ruthenium, bis(tertbutylpentadienyl) ruthenium, derivatives thereof, and combinations thereof.

54. (Currently Amended) A method for forming a ruthenium material [[-]] ~~containing layer~~ on a low-k material disposed on a substrate surface, comprising:

positioning a substrate ~~containing the~~ comprising a low-k ~~material~~ layer disposed thereon within a process chamber;

~~maintaining~~ heating the substrate [[at]] to a temperature within a range from about 200°C to about 400°C;

exposing the low-k ~~material~~ layer to bis(2,4-dimethylpentadienyl) ruthenium to form a ruthenium-containing compound film thereon;

purging the process chamber with a purge gas;

~~reducing~~ exposing the ruthenium-containing compound film ~~with~~ to a reducing gas comprising ~~oxygen~~ ammonia and atomic hydrogen while forming a ruthenium layer on the low-k layer; and

purging the process chamber with the purge gas.

55. (Currently Amended) A method for forming a ruthenium material [[-]] ~~containing layer~~ on a ~~copper~~ [[-]] barrier material layer disposed on a substrate surface, comprising:

positioning a substrate ~~containing~~ comprising a tantalum-containing barrier layer disposed thereon ~~material~~ within a process chamber;

~~maintaining~~ heating the substrate [[at]] to a temperature within a range from about 200°C to about 400°C;

exposing the tantalum-containing ~~material~~ barrier layer to bis(2,4-dimethylpentadienyl) ruthenium [[to]] while forming a ruthenium-containing compound film thereon;

purging the process chamber with a purge gas;

~~reducing~~ exposing the ruthenium-containing compound film ~~with~~ to a reducing gas comprising ~~oxygen~~ ammonia and atomic hydrogen while forming a ruthenium layer on the tantalum-containing barrier layer; and

purging the process chamber with the purge gas.

56. (New) The method of claim 5, wherein the reducing gas further comprises nitrogen gas.

57. (New) The method of claim 56, wherein the ruthenium-containing compound comprises bis(2,4-dimethylpentadienyl) ruthenium.

58. (New) The method of claim 12, wherein the reducing gas further comprises hydrogen gas.

59. (New) The method of claim 58, wherein the reducing gas further comprises atomic-hydrogen.

60. (New) The method of claim 23, wherein the reducing gas further comprises hydrogen gas.

61. (New) The method of claim 60, wherein the reducing gas further comprises atomic-hydrogen.

62. (New) The method of claim 31, wherein the reducing gas further comprises hydrogen gas.

63. (New) The method of claim 62, wherein the reducing gas further comprises atomic-hydrogen.

64. (New) The method of claim 36, wherein the reducing gas further comprises nitrogen gas.

65. (New) The method of claim 64, wherein the reducing gas further comprises atomic-hydrogen.

66. (New) The method of claim 49, wherein the reducing gas further comprises atomic-hydrogen.

67. (New) The method of claim 54, wherein the reducing gas further comprises nitrogen gas.